WHAT IS CLAIMED:

Sub A1

1. A system for performing a simulated medical procedure, comprising:

(a) a simulated organ;

(b) a simulated instrument for performing the simulated medical procedure on said simulated organ;

(c) a locator for determining a location of said simulated instrument within said simulated organ; and

(d) a visual display for displaying images according to said location of said simulated instrument within said simulated organ for providing visual feedback, such that said images simulate actual visual data received during an actual medical procedure as performed on an actual subject, said visual display including:

(i) a mathematical model for modeling said simulated organ according to a corresponding actual organ, said model being divided into a plurality of segments;

(ii) a loader for selecting at least one of said plurality of segments for display, said at least one of said plurality of segments being selected according to said location of said simulated instrument within said simulated organ;

(iii) a controller for selecting a simulated image from said segment according to said location of said simulated instrument; and

(iv) a displayer for displaying said simulated image.

2. The system of claim 1, wherein said visual displayer further comprises:

(v) a texture mapping database for storing texture mapping data; and

(vi) a texture mapping engine for overlaying said simulated image with said texture mapping data substantially before said simulated image is displayed by said displayer.

Sub B3

3. The system of claim 2, wherein said texture mapping is animation of random movement of said simulated instrument and random movement of said simulated organ.

4. The system of claim 1, wherein said texture mapping includes images obtained from performing said actual medical procedure on said actual subject.

5. The system of claim 4, wherein said images are obtained by first recording said visual data during said performance and then selecting said images from said recorded visual data.

6. The system of claim 1, wherein said mathematical model features a plurality of polygons constructed according to a spline, said spline determining a geometry of said mathematical model in three dimensions.

7. The system of claim 6, wherein a deformation in said mathematical model corresponding to a deformation in said simulated organ is determined by altering said spline.

8. The system of claim 7, wherein said deformation in said simulated organ is a local deformation, said local deformation of said simulated organ being determined according to said mathematical model by adding polygons to a portion of said mathematical model, such that said portion of said mathematical model is deformed to produce said local deformation.

9. The system of claim 6, wherein said mathematical model is constructed from said spline by modeling said simulated organ as a straight line and altering said spline until said mathematical model fits said corresponding actual organ.

10. The system of claim 9, wherein said controller selects said simulated image according to at least one previous movement of said simulated instrument within said simulated organ.

11. The system of claim 1, wherein said displayer further displays a graphical user interface.

12. The system of claim 11, wherein said graphical user interface displays tutorial

information for aid in performing the medical procedure.

13. The system of claim 1, wherein said simulated organ is a gastro-intestinal tract.

14. The system of claim 13, wherein said gastro-intestinal tract is constructed from a semi-flexible, smooth material.

15. The system of claim 13, wherein said simulated instrument is an endoscope, said endoscope featuring a sensor for determining a location of said sensor in said gastro-intestinal tract, the system further comprising:

(e) a computer for determining said visual feedback according to said location of said sensor.

16. The system of claim 15, further comprising a tactile feedback mechanism for providing simulated tactile feedback according to said location of said tip of said endoscope.

17. The system of claim 16, wherein said tactile feedback mechanism is contained in said gastro-intestinal tract, and said gastro-intestinal tract further comprises:

(i) a plurality of servo-motors;

(ii) a piston operated by each of said plurality of servo-motors, said piston contacting said semi-flexible material; and

(iii) a controller for controlling said plurality of servo-motors, such that a position of said piston is determined by said controller, and such that said position of said piston provides said tactile feedback.

Sub B2 18. The system of claim 16, wherein said tactile feedback mechanism is located in said endoscope, and said endoscope further comprises:

(i) a guiding sleeve connected to said tip of said endoscope;

(ii) at least one ball bearing attached to said guiding sleeve for rolling along an inner surface of said gastro-intestinal tract;

(iii) at least one linear motor attached to said guiding sleeve;

(iv) a piston operated by said linear motor, said piston contacting said inner surface

of said gastro-intestinal tract; and

(v) a controller for controlling said linear motor, such that a position of said piston is determined by said controller, and such that said position of said piston provides said tactile feedback.

19. The system of claim 16, wherein said tactile feedback mechanism features:

(i) a plurality of rings surrounding said endoscope, each ring having a different radius, at least a first ring featuring a radius greater than a radius of said endoscope and at least a second ring featuring a radius less than said radius of said endoscope, said radius of each of said plurality of rings being controlled according to a degree of inflation with air of each of said plurality of rings, said radius of said rings determining movement of said endoscope;

(ii) an air pump for pumping air into said plurality of rings;

(iii) at least one tube for connecting said air pump to said plurality of rings; and

(iv) an air pump controller for determining said degree of inflation with air of said plurality of rings by controlling said air pump.

20. The system of claim 19, wherein said at least one tube is two tubes, a first tube for pumping air into said plurality of rings and a second tube for suctioning air from said plurality of rings, and said air pump pumps air into said plurality of rings and sucks air from said plurality of rings, such that said degree of inflation with air of said plurality of rings is determined by alternately pumping air into, and suctioning air from, said plurality of rings.

21. The system of claim 16, wherein said gastro-intestinal tract is a substantially straight tube, such that said tactile feedback and said visual feedback are substantially independent of a geometrical shape of said gastro-intestinal tract.

22. The system of claim 16, wherein said tactile feedback mechanism is operated according to tactile feedback obtained during said performance of the medical procedure on an actual subject, said tactile feedback being obtained through virtual reality gloves.

23. The system of claim 15, wherein said endoscope further features a handle for

holding said endoscope and a tool unit, said tool unit comprising:

(i) a simulated forceps;

(ii) a channel for receiving said simulated forceps, said channel being located in said handle;

(iii) a tool control unit for detecting a movement of said simulated forceps, said tool control unit being located in said channel and said tool control unit being in communication with said computer, such that said computer determines said visual feedback and said tactile feedback according to said movement of said simulated forceps.

24. The system of claim 23, wherein said tool control unit detects a location of said simulated forceps within said gastro-intestinal tract for providing visual feedback.

25. The system of claim 24, wherein said tool control unit additionally detects a roll of said simulated forceps for providing visual feedback.

26. The system of claim 25, wherein said visual feedback includes a display of a simulated loop of said simulated forceps for performing a polypectomy.

27. The system of claim 23, wherein said tool control unit further comprises:

(1) a light source for producing light, said light source being located in said channel;

(2) a light wheel for alternately blocking and unblocking said light according to said movement of said simulated forceps; and

(3) a light detector for detecting said light, such that said computer determines a movement of said simulated forceps according to said light detector.

28. A method for performing a simulated endoscopic procedure, comprising the steps of:

(a) providing a system for performing the simulated endoscopic procedure, comprising:

(i) a simulated gastro-intestinal tract;

(ii) a simulated endoscope for performing the simulated endoscopic procedure on said simulated gastro-intestinal tract;

(iii) a locator for determining a location of said simulated endoscope within said simulated gastro-intestinal tract; and

(iv) a visual display for displaying images according to said simulated endoscope within said simulated gastro-intestinal tract, such that said images simulate visual data received during an actual medical procedure as performed on an actual subject, said visual display including:

(1) a three-dimensional mathematical model of said simulated gastro-intestinal tract, said model being divided into a plurality of segments;

(2) a loader for selecting at least one of said plurality of segments for display, said at least one of said plurality of segments being selected according to said location of said simulated endoscope within said simulated gastro-intestinal tract;

(3) a controller for selecting a simulated image from said segment according to said location of said simulated instrument; and

(4) a displayer for displaying said simulated image according to said controller, such that said simulated image is a displayed image;

(b) inserting said simulated endoscope into said simulated gastro-intestinal tract;

(c) receiving visual feedback according to said displayed image; and

(d) receiving tactile feedback according to said location of said endoscope within said gastro-intestinal tract.

29. The method of claim 28, wherein said displayed image is determined according to at least one previous movement of said simulated endoscope within said simulated gastro-intestinal tract.

30. A method for displaying simulated visual data of a medical procedure performed on an actual human organ with an actual medical instrument, the method comprising the steps of:

(a) recording actual data from a performance of an actual medical procedure on a

living human patient;

(b) abstracting a plurality of individual images from said actual data;

(c) digitizing said plurality of individual images to form a plurality of digitized images;

(d) selecting at least one of said plurality of digitized images to form a selected digitized image;

(e) storing said selected digitized image as texture mapping data in a texture mapping database;

(f) providing a mathematical model of the actual human organ, said model being divided into a plurality of segments;

(g) selecting one of said plurality of segments from said model for display;

(h) overlaying said texture mapping data from said texture mapping database onto said segment of said model to form at least one resultant image; and

(i) displaying said resultant image.

31. The method of claim 30, wherein said actual data from said performance of said actual medical procedure is selected from the group consisting of video data, MRI (magnetic resonance imaging) data and CAT (computer assisted tomography) scan data.

32. The method of claim 31, wherein step (f) further comprises the steps of:

(i) modeling the actual human organ as a plurality of polygons according to a spline;

(ii) mapping said spline to the actual human organ according to three-dimensional coordinates;

(iii) altering said spline such that said spline fits said actual data.

33. The method of claim 22, wherein said texture mapping data further include animation.

34. The method of claim 33, wherein said animation includes random movement of the actual medical instrument and random movement of the actual human organ.

35. A method for teaching a particular skill required for performance of an actual medical procedure to a student, the actual medical procedure being performed with an actual medical instrument on an actual organ with visual feedback, the method comprising the steps of:

(a) providing a simulated instrument for simulating said actual medical instrument;

(b) providing a simulated organ for simulating said actual organ;

(c) abstracting a portion of the visual feedback of the actual medical procedure;

(d) providing said portion of the visual feedback for simulating the visual feedback; and

(e) manipulating said simulated instrument within said simulated organ by the student according to said portion of the visual feedback, such that a motion of said simulated instrument is the skill taught to the student.

36. The method of claim 35, wherein said portion of the visual feedback includes substantially fewer visual details than the visual feedback of the actual medical procedure.

37. The method of claim 36, wherein said simulated organ is a simulation of a gastro-intestinal tract, and said simulated instrument is a simulation of an endoscope.

38. The method of claim 37, wherein said portion of the visual feedback includes only a geometrical shape of an interior of said gastro-intestinal tract.

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